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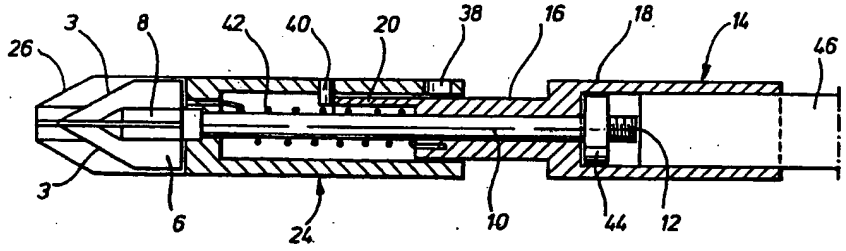

(57) Abstract

A generally cylindrical trocar, for forming a hole in the abdominal wall of a patient to receive a cannula, comprises: cutting means (6); support means (10, 14) for the cutting means, a guard (24) mounted on the support means for axial movement between a forward position in which the guard covers the cutting means and a retracted position in which the cutting means are exposed, and a spring (42) acting between the support means and the guard to bias the guard towards its forward position. The cutting means is provided by two generally triangular blades (2, 4) forming a cruciform blade arrangement with cutting edges (3) inclined to the axis of the trocar.

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A TROCAR

The present invention relates to a trocar.

A trocar is a medical cutting tool used in Laparoscopy. In Laparoscopy a hollow tube or cannula is inserted through the wall of the abdominal cavity of a patient to allow surgical tools to be used within the abdominal cavity. The tools are inserted and withdrawn through the cannula. Any surplus tissue or organ can be withdrawn from the cavity through the cannula. One or more cannulas can be inserted through the abdominal wall according to requirements.

In order to penetrate the abdominal wall, the wall must first be cut and this is accomplished with a trocar. A known trocar is in the form of an elongate shaft supporting at its free end, a head of circular cross-section, which is profiled at its free end portion to form a solid three sided pyramid defining three cutting edges leading away from the tip. The shaft and head are encased in a retractable guard of plastics material. The guard can be displaced longitudinally of the shaft to expose the head but is spring biased so as to envelop the head once any displacement force is removed.

In operation the trocar is inserted into the cannula until its free end projects from the forward end. The cannula and trocar are then urged against the abdominal wall. The resistance of the wall acts to displace the guard and so exposes the cutting edges. The head pierces and cuts the abdominal wall until it emerges from the other side of the wall whereupon, with the resistance of the wall removed, the guard is resiliently displaced to once again cover the head so that the head is prevented from damaging any organs within the abdominal cavity. Continued penetration will allow the cannula to enter the abdominal cavity.

It is an object of the present invention to provide a trocar with improved safety wherein the guard cannot normally be retracted to expose the cutting means and can only be so retracted after rotation of the handle

of the trocar.

According to the present invention there is provided a generally cylindrical trocar, for forming a hole in the abdominal wall of a patient to receive a cannula, comprising: cutting means; support means for the cutting means; a guard mounted on the support means for axial movement between a forward position in which the guard covers the cutting means and a retracted position in which the cutting means are exposed; and spring means acting between the support means and the guard to bias the guard towards its forward position; wherein stop means are provided on the support means and the guard to prevent movement of the guard from its forward position in a first rotary orientation of the guard relative to the support means but to allow movement of the guard from its forward position in a second rotary orientation of the guard relative to the support means, and wherein the spring means acting between the support means and the guard acts to bias the guard and support means into the first relative rotary orientation.

During Laparoscopy, the abdominal cavity is inflated to provide room for the operation to take place. It is thus important that the abdominal wall forms a reasonably air-tight seal around the cannula.

A major problem with known trocars is that the solid pyramidal form of the cutting head presents a high resistance to penetration and this means that the surgeon has to apply considerable force before the trocar penetrates the abdominal wall. Often the surgeon will rotate the tool while pressing to achieve penetration and this action damages the tissue at the point of entry. Also penetration can occur suddenly after some hard pushing. Some surgeons will often effect a starter incision with a scalpel to ease penetration by the trocar.

In the known trocar, the cutting head is surrounded by a relatively thick plastics sleeve and thus the diameter of the hole made by the cutting head is substantially less than that of the cannula to be

inserted. This means that further hard pushing is required to force the cannula into the hole with consequent stretching and tearing of the tissue of the abdominal wall.

In a preferred embodiment of the present invention the cutting means comprises a plurality of laminar blades lying in angularly spaced radial planes and having cutting edges inclined to the axis of the trocar and extending rearwardly and radially outwardly from a common point on the axis of the trocar.

Embodiments of the prevent invention are described below, with reference to the accompanying drawings in which:

Figure 1 shows two blades used in a trocar;

Figure 2 is a side view of a blade arrangement and a supporting rod;

Figure 3 is a horizontal cross-sectional view of a supporting connector;

Figure 4 is a side view of the supporting connector;

Figure 5 is an end view of the supporting connector;

Figure 6 is a vertical cross-sectional view of a guard;

Figure 7 is a plan view of the guard;

Figure 8 is an end view of the guard from its leading end;

Figure 9 is a cross-sectional view of the assembled trocar with the guard in a forward position; and

Figure 10 is a cross-sectional view of the assembled trocar with the guard in a retracted position.

As shown in Figure 1, the cutting means of the trocar is provided by two generally triangular laminar double blades 2 and 4 made, for example, of amorphous nickel, stainless steel or titanium. The blades 2 and 4 have cutting edges 3. A slot 5 extends from the apex of blade 2 and a slot 7 extends from the base of the blade 4.

As can be seen in Figure 2, a cruciform blade arrangement 6 is produced by fitting the blades 2 and 4 together by means of the slots. In this embodiment the blade arrangement has, in effect, four blades which lie in radial planes spaced 90° apart around the axis of the trocar. The cutting edges 3 of the blades are inclined to the axis of the trocar and extend rearwardly and radially outwardly from a common point on the axis of the trocar which defines the tip of the cutting means. In other embodiments the blade arrangement may not comprise four blades but may comprise, for example, three, five, six or seven or more blades.

The blade arrangement as shown is inserted into cruciform slots provided in the head 8 of an elongate rod 10 so that the cutting edges project from the head. The greatest diameter of the blade arrangement 6, ie the length of the base of each triangular blade, is much greater than the diameter of the head. The diameter of the head is greater than the diameter of the shank of the rod. The end of the shank remote from the head is provided with a screw thread 12 for receiving a nut.

The supporting means of the trocar includes a connector 14 shown in Figures 3 to 5. Referring to Figure 3, the connector 14 comprises two coaxial generally cylindrical portions 16 and 18. The leading cylindrical portion 16 has an external diameter smaller than that of the rear cylindrical portion 18. The leading cylindrical portion 16 has an internal diameter substantially equal to the diameter of the elongate rod 10.

The leading cylindrical portion 16 includes a part-cylindrical projection 20. The part-cylindrical projection is coaxial with the leading cylindrical portion 16 and has an equal external diameter.

The leading cylindrical portion 16 also includes a hole 22 bored parallel to the axis of the connector for receiving one end of a helical spring as described below.

The trocar includes a guard as shown in Figures 6, 7 and 8. The guard 24 is generally cylindrical with a

leading end 26 partly tapering towards the axis and towards the front end of the guard. The guard includes three co-axial bores of different diameters. The leading bore 28 has a diameter substantially equal to the diameter of the head portion 8 of the elongate rod 10. The middle bore 30 has a diameter substantially equal to the diameter of the shank of the elongate rod 10. The rear bore 32 has a diameter substantially equal to the external diameter of the leading cylindrical portion 16 of the connector 14. The external diameter of the guard is substantially equal to the external diameter of the rear cylindrical body 18 of the connector 14.

The guard includes a hole 34 bored parallel to the middle bore for receiving one end of a helical spring, and a radial hole 36 for receiving a pin. A further radial hole 38 is provided for inspection purposes.

Cruciform slots 27 extend from the front of the leading end 26 towards the rear end of the guard for a distance approximately equal to the length of the leading bore 28.

The trocar is assembled as shown in Figures 9 and 10.

The leading cylindrical portion 16 of the connector 14 is inserted into the rear end of the guard 24 and comes to rest as the part cylindrical projection 20 abuts against a pin 40 located in hole 36 of the guard 24. A helical spring 42 is connected between hole 22 in the connector and hole 34 in the guard and is located within the chamber formed by the insertion of the connector into the guard. The spring acts to bias the guard to a rotary orientation relative to the connector such that the projection 20 abuts against the pin 40.

The elongate rod 10 is inserted through the front end of the guard and comes to rest when its head 8 is stopped at the rear of the bore 28. The elongate rod is therefore at rest with its shank located within the chamber formed by the guard and the connector and enclosed within the helical spring. The end of the elongate rod

extends into the rear cylindrical body 18 of the connector 14. The end of the rod 10 is retained in the rear cylindrical portion 18 of the connector by a nut 44. A handle 46 fitted into the rear cylindrical portion of the connector bears on the end of the rod 10.

The head 8 of the rod 10 is located solely within the leading end 26 of the guard 24. The blade arrangement 6, fixed to the head 8 is also located within the leading end 26 of the guard 24. The external diameter of the guard is substantially equal to the greatest diameter of the blade arrangement. The leading end 26 of the guard 24 is scalloped and shaped such that it is recessed between each slot 27 and has a profile similar to the profile of the cruciform blade arrangement.

When the trocar is in the guarded position, as shown in Figure 9, the cutting edges 3 of the blades are housed within the guard; the blades being located in the slots 27. Part of the outer surface of the leading cylindrical body 16 of the connector 14 is coloured green. This colour green can be viewed through the inspection hole 38 in the guard when the guard is in its forward position (Figure 9).

When the connector 14 and the guard 24 are in the relative rotary orientation shown in Figure 9, the projection 20 engages the stop pin 40 and retraction of the guard is prevented.

In operation, as shown in Figure 10, the trocar is pushed against the abdominal wall of a patient. The handle 46 of the trocar is turned slightly and this in turn rotates the connector relative to the guard such that the guard and connector are rotated relative to each other by an angle of 180° to a second rotary orientation.

As the connector is rotated to the second rotary orientation relative to the guard, the part-cylindrical projection 20 is moved out of engagement with the pin 40. The connector and rod are thus able to move axially forward with respect to the guard against the action of the spring 42.

As the head of the rod is displaced axially forward, the cutting edges of the blades emerge through the slots 27 of the guard 24.

The four cutting edges 3 cut into the tissue much in the same way as four scalpels would, and sever the tissue along four radially outwardly extending lines from a central point to create four flaps.

As soon as the cutting edges have cut the abdominal wall, the resilience of the compressed spring 42 urges the guard back to its forward position and returns the guard to its first rotary orientation relative to the connector. The cutting edges are therefore immediately covered within the guard so that no damage can be done to other organs. This will also occur if the trocar is removed from the patient. Part of the outer surface of the leading cylindrical portion 16 of the connector is coloured red so that when the guard is in its retracted position, a red colour can be viewed through the hole 38 indicating that the cutting edges 3 are exposed. This is an additional safety feature for the surgeon since he can check, before he applies further pressure to the trocar to introduce the cannula, that the cutting edges have been covered by the guard.

As the guard has an external diameter substantially equal to the greatest diameter of the blade arrangement, the body wall is hardly stretched and is not torn when the guard comes forward over the cutting blades.

The trocar should be used within a cannula having thin walls and having an internal diameter only slightly greater than the external diameter of the trocar so that the body wall is hardly stretched and is not torn by the insertion of the cannula. The body wall thus maintains an airtight seal with the cannula and is cleanly cut by the trocar so that the healing process is much improved.

The sharpness of the blades of the trocar means that surgeons do not have to apply so much pressure in order to penetrate the abdominal wall. This prevents the

trocar from being suddenly forced through the abdominal wall.

It will be appreciated that other blade arrangements may be used. In particular, it is possible to use two triangular planar blades (not shown) each bent through 90° along the perpendicular bisector of the base. The blades are assembled by placing the perpendicular bisectors of the blades side by side so as to form a cruciform configuration when viewed from above.

If the blade arrangement does not comprise four blades, the head of the rod and the guard will be modified to accommodate the number of blades provided.

CLAIMS

1. A generally cylindrical trocar, for forming a hole in the abdominal wall of a patient to receive a cannula, comprising: cutting means; support means for the cutting means; a guard mounted on the support means for axial movement between a forward position in which the guard covers the cutting means and a retracted position in which the cutting means are exposed; and spring means acting between the support means and the guard to bias the guard towards its forward position; wherein stop means are provided on the support means and the guard to prevent movement of the guard from its forward position in a first rotary orientation of the guard relative to the support means but to allow movement of the guard from its forward position in a second rotary orientation of the guard relative to the support means, and wherein the spring means acting between the support means and the guard acts to bias the guard and support means into the first relative rotary orientation.

2. A trocar as claimed in Claim 1, wherein indicator means are provided to indicate whether or not the guard is forward and the guard and support means are in the first relative rotary orientation.

3. A trocar as claimed in any preceding claim, wherein the support means comprises an elongate rod and a connector, one end of the elongate rod receiving the cutting means, the other end of the elongate rod being received by the connector and being engaged in use by a handle of the trocar.

4. A trocar as in any preceding claim, wherein the cutting means comprises a plurality of laminar blades lying in angularly spaced radial planes and having cutting edges inclined to the axis of the trocar and extending rearwardly and radially outwardly from a common point on the axis of the trocar.

5. A trocar as claimed in Claim 4, wherein the guard comprises a generally cylindrical body formed with an axial bore and radial slots within which the blades are

located; the guard having a maximum diameter substantially equal to the maximum width of the cutting means.

6. A trocar as claimed in Claim 5, wherein the leading end of the guard is recessed between each slot so that it has a profile similar to the profile of the cutting means.

7. A trocar as claimed in any one of Claims 4 to 6, wherein the cutting means comprises two generally triangular laminar blades locked together in a cruciform configuration and extending at right angles to each other and sharing a common apex and a common mid-point of the base.

8. A trocar as claimed in Claim 7, wherein one said triangular blade has a slot extending from the apex towards the base and the other said triangular blade has a slot extending from the base towards the apex so that the blades can be fitted together in a cruciform arrangement.

9. A trocar as claimed in Claim 5 or Claim 6, wherein the cutting means comprises two generally triangular blades, each blade being bent through a right angle about a line extending from the apex to the base, the blades being positioned so that one half of each of said blades is generally aligned with a first plane and the other half of each blade is generally aligned with a second plane extending at right angles to the first plane.

10. A trocar substantially as hereinbefore described with reference to the accompanying drawings.

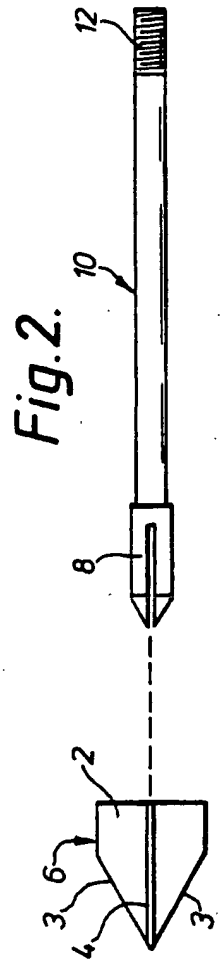

Fig.2.

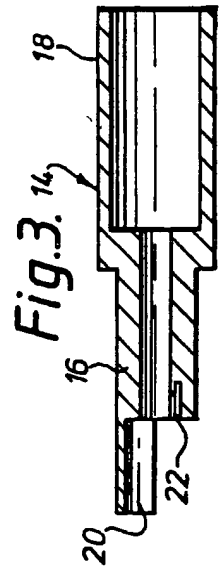

Fig.3.

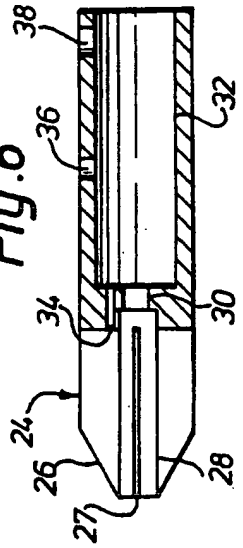

Fig.6

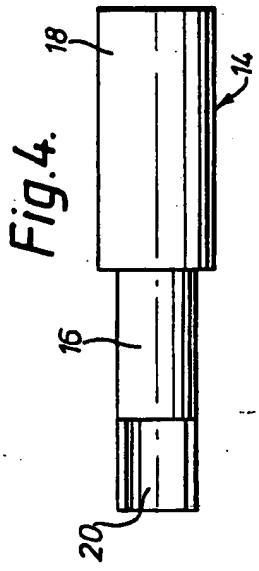

Fig.4.

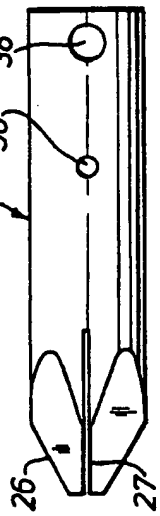

Fig.7

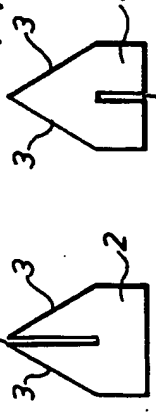

Fig.1.

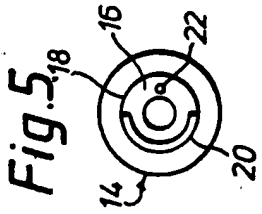

Fig.5.

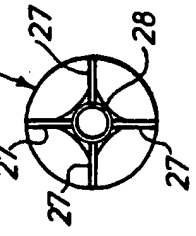

Fig.8.

SUBSTITUTE SHEET

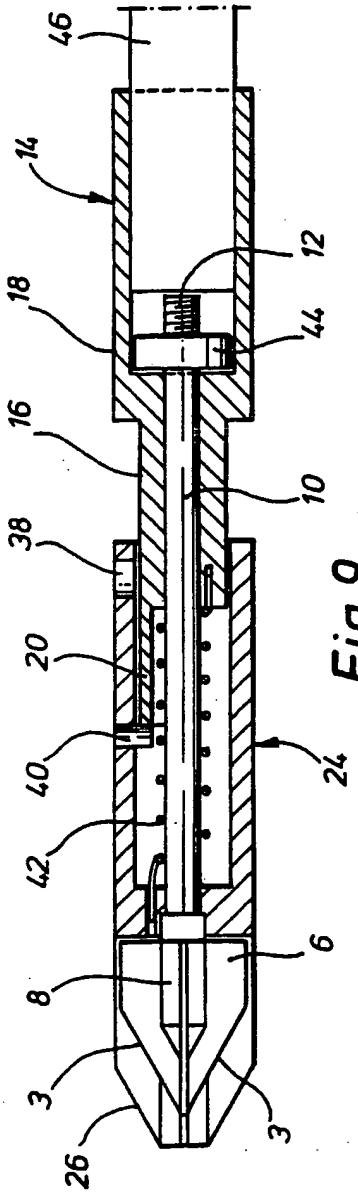

Fig.9.

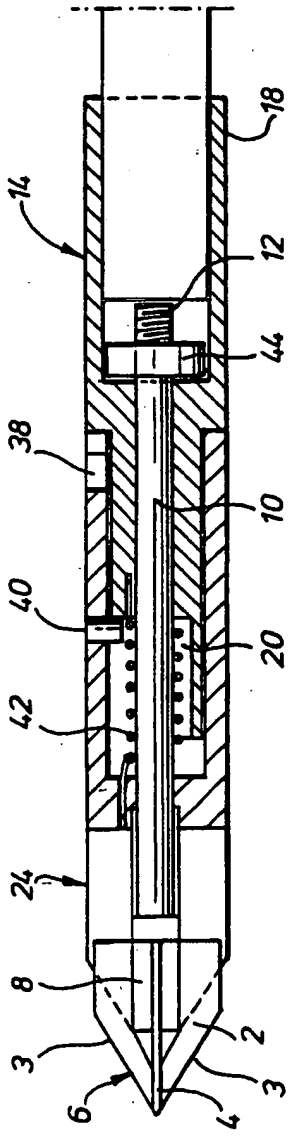

Fig.10.

INTERNATIONAL SEARCH REPORT

Int. ional Application No
PCT/GB 93/01712

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 A61B17/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP,A,0 495 634 (ETHICON) 22 July 1992 see column 4, line 28 - column 6, line 5; figures	1,3 2,4-7
X	WO,A,92 10974 (YOON) 9 July 1992 see page 7, line 17 - page 9, line 27; figures 1,2	1,3
Y	FR,A,2 293 907 (ALBERTO) 9 July 1976 see page 3, line 33 - line 37; figures	2
Y A	DE,U,85 11 787 (SCHNEP-PESCH) 14 August 1986 see the whole document	4-7 8,9
A	WO,A,92 10141 (ADAIR) 25 June 1992	
A	FR,A,1 487 998 (BRUNSWICK) 29 May 1967	

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information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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FR-A-1487998		NONE		